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The Design of Subsea Production Systems for Reliability and Availability

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Abstract

The American Petroleum Institute Recommended Practice 17N (2009) [1] has been created to support the subsea industry in its implementation of reliability management systems for subsea projects. The approach is grounded on a number of key reliability processes that resulted from earlier research at Cranfield University.

While much of the industry is aware of the imminent API RP 17N, the principles of its implementation and direct benefits to the industry have not been widely presented.

Experience has been gained of applying the principles underlying the API RP 17N to a number of field development projects. This experience has identifed that there are some key points in the project life cycle when a real difference can be made to the ultimate performance of the field if specific reliability activities are undertaken. The lessons from the experience of applying these reliability principles to subsea development projects will be presented and will identify the types of problems that projects can be faced with, if they do not adopt the principles defined in API RP 17N.

This paper will introduce these activities and demonstrate, through examples, how they can make a clear positive impact on the design of subsea production systems for improved reliability and availability performance. The importance of carrying out the key reliability activities at the right point in the project life cycle and with the correct inputs, assumptions and direct interaction with the project engineers is essential to the effective implementation of these principles and is at the heart of the API RP 17N.

The importance for organisations throughout the supply chain to embrace these principles will be presented. The paper will also describe how the integration of reliability analysis with engineering design and analysis can support and improve the effectiveness of project decision making.

While the focus of API RP 17N is for subsea projects, it is closely related to ISO 20815 which addresses all areas of oil and gas industry and as such the same principles and experiences can be applied throughout the industry.

Introduction

The reliability performance of subsea equipment used by the oil and gas industry for the production of hydrocarbons has a significant impact on production availability and system life cycle costs. This is particularly true for remote deepwater applications where the cost of intervention for replacement or repair of failed equipment is very high. Over the past two decades, the reliability performance of subsea hardware has been poor [2]. Failures occurring during the early stages of production are particularly significant as these have the greatest adverse impact on project value, damaging the reputation of Operators as well as that of their engineering contractors and suppliers. The causes of early life failure are many and varied. They may be triggered, for example, by design errors leading to system faults and failure modes or more commonly by defects introduced inadvertently during manufacture, construction or installation activities. Reflection on the root causes of failure suggests that failures are far from inevitable and in many cases could have been anticipated and prevented had sufficient attention been placed on their identification, assessment and management at the design stage.